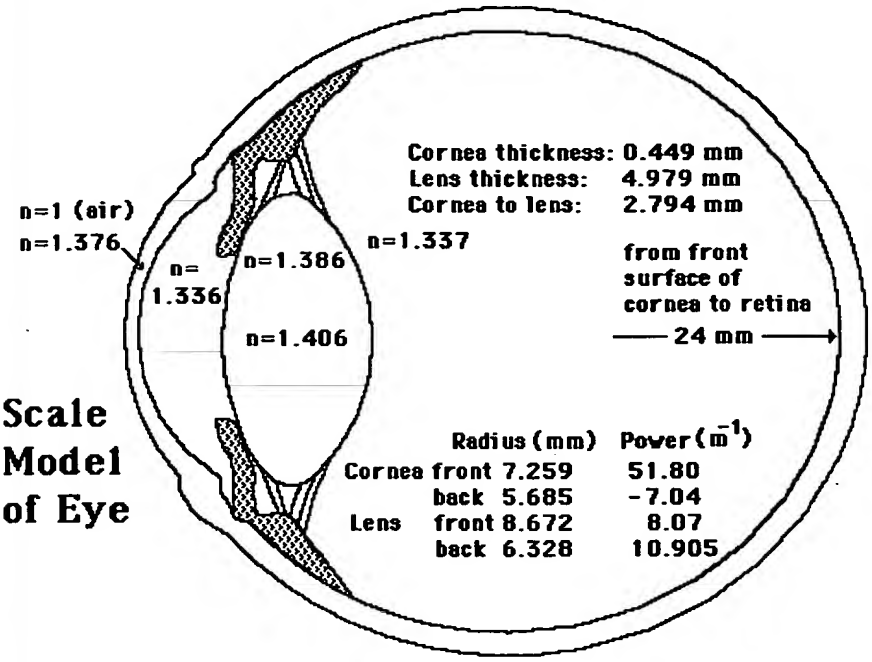
Design of Scale-Model Eye



The scale model eye was developed by scaling an actual cross-sectional picture of an eye from Light & Vision by Mueller & Rudolph. Then a total distance of 2.4 cm from cornea to retina was adopted from Hecht, along with his values for the indices of refraction for all components. The actual measurements for radii of curvature and separation were scaled using a solver program (TK! Solver) until a parallel incoming ray fell on the retina. It is not known whether the eye shown by Mueller&Rudolph is typical.

Index

Vision concepts

Image formation concepts

References
Mueller & Rudolph

Hecht, 2nd Ed.

HyperPhysics***** Light and Vision R Nave

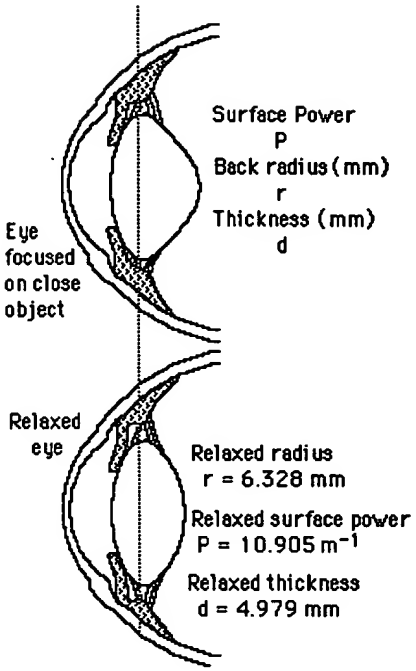
Go Back

Under construction! A Javascript calculation will be added.

Accommodation

Model

Being inherently a thick lens problem, image formation by the eye can be approached using a system matrix. By modeling the fixed portion of the eye with a matrix, assuming the front surface of the crystalline lens to be fixed, then the thickness and back surface power of the lens can be varied to study the accommodation process.



Back surface power of lens | Translation | System matrix through front lens surface

$$\begin{bmatrix} 1 & P \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ \frac{-d}{1.406} & 1 \end{bmatrix} \begin{bmatrix} 0.9827 & 52.06 \\ -.00024 & 0.8892 \end{bmatrix}$$

$$\begin{bmatrix} \text{System Matrix for eye} \end{bmatrix} \begin{bmatrix} \frac{1}{\text{object dist}} \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{1.337}{\text{image dist}} \\ 1 \end{bmatrix}_k$$

By computing the system matrix for the entire imaging process, constraining the image to fall on the retina, the object distance on which the eye is focused can be calculated. (If an image is to be formed, the object distance must be negative since the Cartesian sign convention is used.) Alternatively, by choosing and object distance, the required back surface power can be calculated.

Scale model eye | Discussion of modeling accommodation

Index

Vision concepts

Reference Hecht, 2nd Ed. Sec. 5.7

HyperPhysics***** Light and Vision R Nave

Go Back